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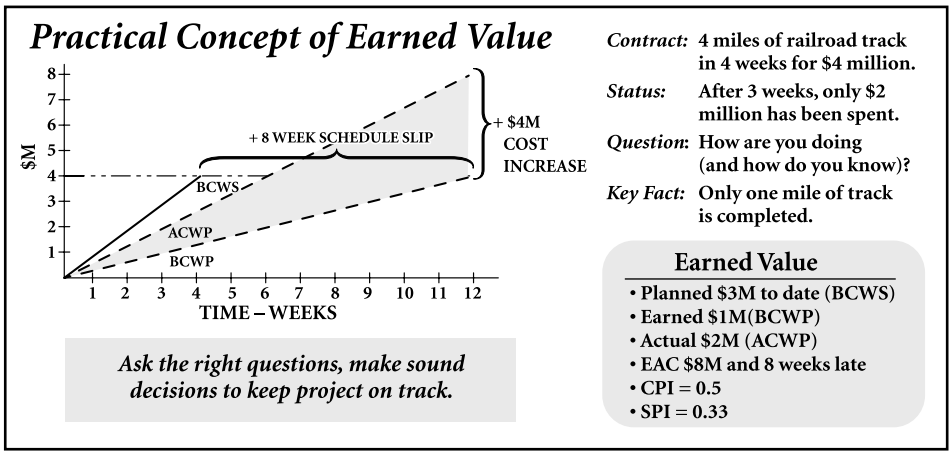
Embracing Earned Value Management For the 21st Century

By Dr. Lawrence J. Delaney,
Assistant Secretary of the Air Force (Acquisition)



Managing aging fleets, improving technologies, and developing new systems—all within a limited budget—is more complicated than ever for the acquisition management community. Yet in spite of these challenges, we have an obligation to manage our projects well.

This means that we must continually assess whether we're meeting our objectives in terms of cost, schedule, and technical performance. Earned Value Management, or EVM, is a tool that can help us ask the right questions, so we can make good decisions about our projects.

At the heart of effective project management is good risk management. Earned Value helps us evaluate and control our risks by allowing us to measure physical progress, in dollars. That progress can then be compared to a baseline schedule (also measured in dollars) and actual costs incurred, so we can see if we have strayed from our plan. EVM helps us objectively see the whole picture, so we can make any

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In This Issue:

Regular Features:

Leadership Corner

Farewell From General Martin

Since July 1998, General Gregory S. Martin has served as principal deputy, Office of the Assistant Secretary of the Air Force for Acquisition. He was recently selected for reassignment as Commander, U.S. Forces in Europe, Commander, Allied Air Forces Central Europe, and Air Force Component Commander, U.S. European Command.

Acquisition reform efforts are paying big dividends for our warfighters, in both reduced costs and faster deliveries. Programs such as JDAM, JASSM, AMRAAM, and AIM-9X are but a few of the programs delivering incredible capability in minimum time and well below early cost estimates. I commend you on your success and urge you to continue to push the envelope in every direction.

We must remember that world-class performance requires strong, dedicated partnerships. Our efforts in streamlining acquisition processes, minimizing documentation, strengthening incentive opportunities, and providing regular feedback to our industry partners helps create an environment of trust and cooperation that spawns the sincere desire and motivation to succeed.

As I go back to the field to become one of your customers, I want you to know that I have thoroughly enjoyed the opportunity to serve with a group of true professionals. I have a great appreciation for the many problems you face and continually overcome in your dedicated efforts to deliver superb equipment to our warfighters. Our nation is lucky to have you shouldering the load you carry and I have definitely taken more from you than I have given in return. I am deeply grateful. Thank you and have a great New Year!

Embracing Earned Value Management For the 21st Century

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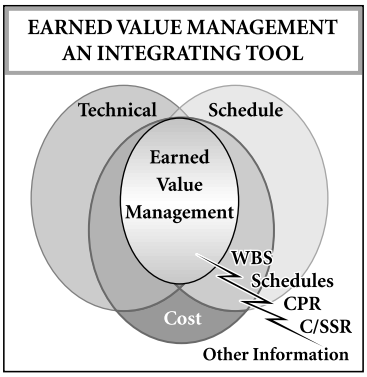

corrections needed to keep our projects on track.

We must continue to work with our Industry partners to integrate management disciplines where it makes sense. EVM, cost estimating, and cost-risk management are related disciplines that, when integrated, can produce a cost, schedule, technical, and management synergy that will result in more effective acquisition management.

By making it our priority to use EVM on every project, integrate EVM with cost-risk management, and synergize EVM with cost estimating, we'll get more for every defense dollar spent. It's up to all of us to implement and improve EVM in the years to come.

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The SAF/AQ Mission
"Assuring dominant aerospace power...

- World-class technology
- Streamlined acquisition
- Affordable and effective systems, supplies, and services

...for the warfighter."

The opinions expressed in this newsletter are not necessarily those of the United States Air Force, its employees, or subcontractors.

In The Next Issue: The March/April issue will highlight Reduction in Total Ownership Cost (R-TOC). If you would like to contribute articles, contact us at ***arnews@pentagon.af.mil.***

An Introduction to Earned Value, For What It's Worth

Lately, you may have heard a lot of talk about "Earned Value Management," or EVM. Although the concept of Earned Value originated more than thirty years ago, it has recently re-emerged as one of the most important and effective project management tools available.

What Exactly Is Earned Value, Anyway?

Earned Value is the key element in the EVM methodology. Earned Value can be thought of as physical progress. It relates the value earned for a project by integrating three elements: 1) Budgeted Cost for Work Scheduled (BCWS) or the budgets of the activities planned to be completed; 2) Actual Cost of Work Performed (ACWP), or the real cost of the work charged against the completed activities; and 3) Budgeted Cost of Work Performed (BCWP), or the planned cost of the activities that were actually completed. BCWP is also referred to as "Earned Value."

The Practical Benefits of EVM

At this point, you may be thinking, "So, EVM allows for progress on a project to be measured. That sounds like a relatively simple concept. But why should I make the effort to employ it? What can it actually *do* for my project?"

Earned Value is significant because it provides a yardstick that project managers can use to objectively measure work accomplished. If you asked 10 people on a given project how well things were going, you would likely get just as many different answers. EVM reduces subjectivity and allows for consistency in evaluating progress.

EVM integrates cost, schedule, and technical performance into a single metric so managers can make effective comparisons. By using the same unit of measurement (typically expressed in dollars or work hours) for both physical progress and cost, Earned Value helps project managers compare planned and completed work.

In a nutshell, EVM enables project managers to:

- Clearly define the scope of the project before beginning work;
- Credibly request appropriate resources;
- Objectively measure work accomplished;
- Identify problem areas early;
- Realistically project cost-to-complete; and
- Limit the inclination of clients or superiors to add work without increasing the project's budget.

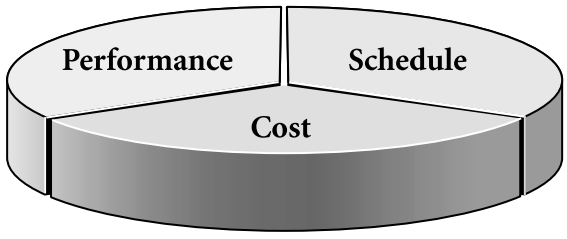
EVM allows management to assess what is being achieved with program dollars by analyzing the expenditure of funds in light of work *accomplished*, not merely scheduled.

The Bottom Line

Earned Value data helps managers make critical decisions about their projects. For instance, if a project is behind schedule, the project manager may ask questions such as: How does my EVM schedule data compare to my critical path schedule data? How important is schedule? Can I afford to work overtime to recover lost time? Is it possible to perform tasks concurrently? Are there any technical solutions that could help speed up progress? Is the project over budget? Is it possible to reschedule tasks? Are there tasks that can be eliminated? Are there less costly facilities I can use? Earned Value provides project managers with the information they need to answer these questions.

While EVM requires some up-front work to initiate, its benefits are tremendous. With the information Earned Value provides, management can take action when necessary to put a project back on track, avoiding a potential problem.

The Elements of EVM



Earned Value provides for balanced management oversight for technical performance, cost, and schedule factors.

The ABCs of EVM:
Using Earned Value On Your Project

The terminology used in EVM can be confusing. But don't let the alphabet soup of acronyms frustrate you. Only three basic components are necessary to perform Earned Value analysis: Budgeted Cost for Work Scheduled (BCWS), Actual Cost of Work Performed (ACWP), and Budgeted Cost of Work Performed (BCWP). All other elements can be derived from them.

Getting Started

There are 5 basic steps in setting up an EVM system:

1) Establish a Work Breakdown Structure (WBS) to define the activities that constitute 100% of the project's scope.
2) Break down each of the major activities into measurable tasks.
3) Allocate the costs that will be expended on each activity and assign responsibility for performance of each task.
4) Develop a Project Master Schedule (PMS) to plot all of the activities over time.
5) Analyze the WBS and PMS to ensure they are viable.

Once you've completed these steps, you can use the information to perform cost performance analysis.

Reporting Progress

Remember to update the PMS by reporting progress. Activities should be reported as started, completed, or with a remaining duration. The percent of activities remaining should be reported, as well. Avoid subjectivity by using special earning rules, such as the milestone method or 50-50 rule (see box on page 5 for more details).

Determining Actual Costs

Enter the actual costs from time sheets and invoices. You will need to determine how to allocate costs to specific activities. This can be done in an automated or manual fashion. However, no matter which method is chosen, it is highly recommended that human analysis be performed to ensure that data is properly entered and appropriated.

Doing the Math

Remember Calculus class? Now forget it. Compared to that, Earned Value analysis will be a piece of cake. Following are several calculations you can use to analyze how your project is doing.

(Continued on page 5)

Earned Value Management Criteria

Earned Value Management (EVM) criteria were introduced in the 1960s by the DoD. The 32 criteria describe minimum standards that contractor management systems are required to meet. They are organized into 5 parts that embody widely recognized basic management principles:

1) Organization
2) Planning and Budgeting
3) Accounting
4) Analysis and Management Reports
5) Revisions and Data Maintenance

Originally, the criteria were used by the Air Force as cost/schedule planning and control specifications (C/SPEC) for application of major defense acquisition contracts. Later, they were adopted by all military services as cost/schedule control systems criteria (C/SCSC). Since then, they have been revised and renamed Earned Value Management systems criteria. Proper contractor EVM system implementation is the responsibility of the Defense Contract Management Command (DCMC).

Each of the criteria addresses a principle necessary for effective management of large, risky, flexibly priced defense projects. For example, one criterion requires that each element of work on the project has a schedule. Another requires that each element of work has a budget. A sufficient management control system that promotes proper planning and integration of work on a project is vital to the effective use of EVM. EVM criteria can act as a foundation for performance analysis and as a reference tool for scheduling, planning, and budgeting projects.

To view the EVM criteria in their entirety, visit *http://www.acq.osd.mil/pm/currentpolicy/jig/evmig2.htm*. For information about DCMC, see *http://www.dcmc.hq.dla.mil*.

The ABCs of EVM: Using Earned Value on Your Project

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Earned Value

Earned Value (BCWP) is the fraction complete for an activity multiplied by its budget.
BCWP = Fraction Complete X Budget

Schedule and Cost Variance

Schedule Variance (SV) is the Earned Value minus the planned budget for the completed work.
SV = BCWP - BCWS

Cost Variance (CV) is the Earned Value minus the actual cost for the completed work.
CV = BCWP – ACWP

Schedule and Cost Performance Indices

Schedule Performance Index (SPI) is the Earned Value divided by the planned value of the completed work.
SPI = BCWP/BCWS

Cost Performance Index (CPI) is the Earned Value divided by the actual cost of the completed work.
CPI = BCWP/ACWP

Estimate At Completion

The Estimate At Completion (EAC) is an important tool used to forecast the final cost for a project. This figure can then be compared with the amount that was appropriated for the project, or its Budget At Completion (BAC).

$$EAC = \frac{(BAC - BCWP)}{CPI} + ACWP$$

As you can see, using EVM is relatively painless, and its benefits are easy to recognize. By performing these simple calculations, Earned Value data can provide project managers with valuable insight into the cost and schedule status of their projects.

Special Earning Rules

Milestone Method: Report percentage complete based on discrete milestones. For example, for the creation of a report, consider 10% complete when the research is done, 30% when the first draft is written, 50% when the first draft is reviewed, 60% when the second draft is written, 80% when the second draft is reviewed, and 100% when the final is delivered.
50-50 Rule: Consider each activity 50% complete when its start date is reported, and 100% complete when its finish date is reported. Used only with work packages of very short duration.

TOP 10 BENEFITS OF EVM

1. It is a single management control system that provides reliable data.
2. It integrates work, schedule, and cost using a work breakdown structure.
3. The associated database of completed projects is useful for comparative analysis.
4. The cumulative cost performance index (CPI) provides an early warning signal.
5. The schedule performance index (SPI) provides an early warning signal.
6. The CPI is a predictor for the final cost of the project.
7. It uses an index-based method to forecast the final cost of the project.
8. The “to complete” performance index allows for evaluation of the forecasted final cost.
9. The periodic (e.g., weekly or monthly) CPI serves as a benchmark.
10. The management by exception principle can reduce information overload.

EVM Education & Training

Defense Systems Management College (DSMC) offers the following Earned Value Management courses:

Fundamentals of Earned Value Management [BCF 102]. An 8-day introductory course addressing EVMS criteria, planning and scheduling, and effective use of EV reports. See *http://www.dsmc.dsm.mil/courses/crsdesc/bcf102.htm.*

Intermediate Earned Value Management [BCF 203]. A 10-day course that teaches students how to prepare EVM requirements, evaluate a contractor’s management system against EVM criteria, and execute an IBR. See *http://www.dsmc.dsm.mil/courses/crsdesc/bcf203.htm.*

Advanced Program Management [PMT 302]. A 14-week course covering the various interrelated disciplines of program management, including EVM. See *http://www.dsmc.dsm.mil/courses/crsdesc/pmt302.htm.*

EVIPT Breathes New Life Into Earned Value Management

The Air Force Earned Value Integrated Process Team (EVIPT), originally chartered in June 1996, has been re-established to invigorate Earned Value Management (EVM) use within the Air Force. Its membership consists of highly skilled EVM experts in the financial and program management disciplines. The group has met twice within the last few months to discuss critical EVM issues, including earned value policy, roles and responsibilities, use of EVM data as a management tool, education and outreach strategies, conferences and training sessions, and EVM resources.

Leadership for the Air Force EVIPT is the dual responsibility of SAF/AQX and SAF/FMC, with AQX as the Office of Primary Responsibility (OPR). The EVIPT's primary purpose is to develop and implement Air Force earned value policy and to provide a forum to collectively resolve interpretation issues. In addition, the EVIPT is responsible for addressing the state of EVM implementation and resource capability currently existent within the Air Force acquisition community.

In addition to the Air Force EVIPT, the Office of the Secretary of Defense (OSD) has recently chartered an EVIPT. OUSD (AT&L) will chair the IPT with representation from the Army, Navy, Air Force, Defense Contract Management Command (DCMC), Defense Systems Management College (DSMC), Ballistic Missile Defense Organization (BMDO), and National Reconnaissance Office (NRO). The OSD IPT will work to identify obstacles for effective EVM use, evaluate the adequacy of EVM expertise in the DoD, review the IBR process, and recommend changes. One important outcome will be to ensure effective communication between the EVM Executive Agent (DCMC-OC) and the program management community.

Lt. Col. Laura Martin (SAF/AQXA) is the EVIPT leader for the Air Force EVIPT, as well as the Air Force representative on the OSD EVIPT. She can be reached by e-mail at *Laura.Martin@pentagon.af.mil.*

JDAM Program Office Wins Schriever Award

The Joint Direct Attack Munitions (JDAM) System Program Office at Eglin AFB was recently honored with the 1999 Gen. Bernard A. Schriever Award for best Program Executive Office in the Air Force. The award is based on an evaluation of customer focus, management and analysis, human resource development, long-range strategic planning, and customer satisfaction.

JDAM is a joint Air Force/Navy program that provides current fighter and bomber aircraft the capability to accurately attack land and maritime targets under adverse weather conditions from medium and high altitudes.

During the Kosovo campaign, the JDAM team was called on by top defense officials to accelerate production of the weapon for use by aircrews flying night missions in the Balkans. In just nine hours, the JDAM team completed a contract with Boeing to produce more JDAMs – a feat that normally takes 90 days. JDAM was the first bomb dropped in the Balkan campaign. By conflict's end, 652 JDAMs had been dropped.

Oscar Soler, JDAM program director, said "The feedback we received from the warfighters was that it was even more reliable and accurate than they expected."

Competition for the Gen. Benard A. Schriever Award is fierce. Approximately 40 programs compete for the award each year.

New Start Update

To ensure compliance with new start notification procedures, SAF/AQ will develop and conduct a training program for Air Force Materiel Command (AFMC) Product and Logistics Centers from January through March 2000. SAF/AQ will also issue interim changes to AFI 63-101, Acquisition Systems, and the Air Force Federal Acquisition Regulation Supplement (AFFARS) in the coming weeks.

Look for more on this topic in the March/April 2000 issue.

ALR Week Coming in May

Mark your calendars... Acquisition and Logistics Reform (ALR) Week will be held May 22-26, 2000. ALR Week provides an opportunity for acquisition professionals at all levels to assess ongoing reform initiatives and investigate ways to accelerate their implementation.

Details on this exciting annual event will be published as they are available on the Air Force Acquisition Reform website at ***http://www.safaq.hq.af.mil/acq_ref/***.

Success Stories

Earned Value Helps Air Force Software Division Excel

By Walter Lipke, Deputy Chief
Oklahoma City Air Logistics Center, Software Division

For nearly 15 years, the Oklahoma City Air Logistics Center's Software Division at Tinker AFB has successfully applied Earned Value Management on its software projects. Its utility was immediately apparent upon implementation in 1985. EVM gave us a way to look into what was happening on a project and take corrective action, if needed.

EVM has evolved since we first put it into practice. Initially, it was cumbersome due to paper-based data collection. Now, data collection is automated, making it much easier to use.

At first, there was a common myth that EVM could only be used on large development projects. Today, EVM is applied to both software maintenance and development projects. It is equally useful on small projects that last a few months, and large projects lasting several years. The return on investment of software process improvement, which included applying EVM, was determined in 1994 to be 8.5 to 1.

We have had tremendous success as a result of our commitment to EVM. In 1993, the Test Program Set (TPS) and Industrial Automation (IA) functions of the Software Division became the first Air Force software activity to achieve Software Engineering Institute (SEI) Capability Maturity Model (CMM) Level 2. In 1996, they became the first in federal service to achieve Level 4 distinction. EVM was largely responsible for achieving this high level of organizational maturity by providing process indicators.

In September 1998, the TPS and IA software functions achieved ISO 9001 and TickIT registration, an international standard of quality. In May 1999, they were named Institute of Electrical and Electronic Engineers (IEEE) Computer Society winner of the Software Process Achievement Award, a very prestigious honor.

Walter Lipke is a professional engineer and holds a Master's degree in Physics. He recently presented on software and EVM at the 11th Annual International Integrated Program Management Conference at Tyson's Corner, VA, discussing his March 1999 article from the journal Crosstalk, *"Applying Management Reserve to Software Project Management." He can be contacted by e-mail at* **Walter.Lipke@tinker.af.mil**.

B-2 Bomber Team's EVM Innovations Make Program Soar

By Paul J. Solomon, B-2 EVMS Program Director
Northrop Grumman Corporation

Earned Value Management successes are common at Northrop Grumman. The company has a long-standing policy to use EVM at all of its operating elements. In particular, the B-2 Spirit Stealth Bomber Program in Northrup Grumman's Integrated Systems and Aerostructures Sector demonstrates how successful EVM can be when used as part of an evolving, common integrated program management process.

The B-2 Spirit Stealth Bomber Program implemented several innovative process improvements using EVM. These include integrating Earned Value with systems engineering processes, defining improved software engineering metrics to support EVM, and developing a leaner, more effective methodology called Performance-Based Earned Value (PBEV). PBEV makes Earned Value less costly to administer and more effective as a measure of progress by reducing focus on small tasks. Instead, key metrics are defined at higher levels to best measure technical performance.

These changes paid off during upgrades of the B-2 weapon system. One of those upgrades was the development of the Joint Standoff Weapon/Generic Weapon Interface System (JSOW/GWIS), a software-intensive effort. The new metrics helped to make it a very successful program. The PBEV methodology was used to ensure that the warfighter received the most functionality from software development efforts. On JSOW, we provided 85% more capability than originally planned, on schedule and under budget.

Since the beginning of the B-2 program in the early 1980s, many lessons have been learned. Now Earned Value is used more effectively than ever. While its use does not guarantee that programs will stay within cost and schedule targets, it does allow program managers to independently assess performance data and take prompt actions.

Paul Solomon is a member of the National Defense Industrial Association Program Management Systems Subcommittee Team, which wrote the "Industry Standard Guidelines for EVMS." He shares lessons learned and best practices with the defense industry at the DoD Software Technology Conference, the Integrated Program Management Conference, and on the Software Program Managers Network. He can be reached at **solompa@mail.northgrum.com**.

ADATP Builds Solidarity in Acquisition Workforce

The Association of Defense Acquisition & Technology Professionals (ADATP) is a new non-profit association dedicated to defense acquisition and technology professionals. ADATP strive to serve as a forum to critique acquisition policy and process, while providing feedback to DoD leadership on matters impacting the acquisition workforce.

ADATP cuts across all acquisition career fields and military departments. It brings together logisticians, contracting specialists, engineers, information technologists, and other members of the acquisition and technology workforce, while promoting the team approach in the spirit of broad-based acquisition reform.

George Krikorian, former Forrestal-Richardson Memorial chair at the Defense Systems Management College (DSMC), serves as ADATP's interim Executive Director.

Membership provides a networking forum for acquisition and technology professionals, continuing education and training, a monthly magazine on current policy matters and workforce issues, and a means to communicate opinions of the defense acquisition workforce to various DoD elements.

For more information about ADATP, fill out an "Expression of Interest Form" at www.adatpro.org or call (703) 247-2561.

Upcoming Events

AIAA Acquisition Reform Conference 2000

"Acquisition and Logistics Reform: The Roads Traveled... The Roads Ahead" is scheduled for 27-28 January in Washington, DC. Visit ***http://ww.aiaa.org*** or call 1-800-639-2422.

CEO Conference

Scheduled for 16-17 February, Industry and Air Force leaders will discuss acquisition issues and propose ideas to conduct business more efficiently. Contact Major Carolyn Campbell at ***carolyn.campbell2@pentagon.af.mil***.

College of Performance Management International Conference

"Enhancing the Earned Value Body of Knowledge" is scheduled for 14-17 May in Clearwater, Florida. See ***http://www.acq.osd.mil/pm/16th_annual_college_of_performance_management_international_conference.***

OSD Satellite Broadcast

"Competitive Sourcing: The Challenge and Spirit of A-76" is scheduled for 24 February at 1300 EST. See ***http://www.acq.osd.mil/dau/arcc*** for details.